

Abstract

Risk as a Resource - A New Paradigm

Dr. Michael A. Greenfield* and Mr. Thomas E. Gindorf**

NASA must change dramatically because of the current United States federal budget climate. The American people and their elected officials have mandated a smaller, more efficient and effective government. For the past decade, NASA's budget had grown at or slightly above the rate of inflation. In that era, taking all steps to **avoid the risk** of failure was the rule. Spacecraft development was characterized by extensive **analyses**, numerous reviews, and multiple conservative tests. This methodology was consistent with the long available schedules for developing hardware and software for very large, billion dollar spacecraft. Those days are over. The time when every identifiable step was taken to avoid risk is being replaced by a new paradigm which manages **risk in** much the same way as other resources (**schedule**, performance, or dollars) are managed. While success is paramount to survival, it can no longer be bought with a large growing NASA budget.

NASA's better, faster, cheaper philosophy for doing business will provide the foundation for an exciting space program that delivers more tangible value in products and more **relevance** to the public at significantly lower cost. Pivotal to the success is a new approach to product assurance. The challenge facing NASA today is not failure avoidance at any cost, but **rather reengineering** our processes to reduce the cost of success.

Payloads and unmanned launches will need to be viewed as elements of a successful program rather than discreet projects. In a program, success is achieving the program objectives. In a discreet project, success is achieving **all** of that specific project's objectives, and anything **less** is viewed as some degree of failure, *ranging* from small to catastrophic. With this new program orientation failure of any one element does not necessarily jeopardize program success. Risk perception and success definition must change. The future will see the **skies** replete with arrays of **small** spacecraft. These arrays will be space and time related such that success will depend upon the performance of the **whole**, not **each** discreet element. The New Millennium Program is one such example. Importantly, this new way of doing missions requires a new way of addressing and dealing with **risk**.

The challenge to the product assurance community is to consider a new paradigm where the program manager's resources are limited and hence prohibit strict adherence to the reliability and quality standards of the past. The lessons of the past still provide

important knowledge but they can no longer serve to inhibit progressive new approaches, new concepts of success, development of new tools, and a test program which includes only effective tests which contribute significant value. Risk avoidance at all costs must be replaced with risk sharing based on program structure and resources. In the past, the product assurance community has looked at cost as someone else's responsibility and has demanded all resources necessary to cover every possible eventuality. This has led to exhaustive analyses, reviews, and testing, all with varying degrees of effectiveness. The "new age" requires a new way. This new way includes embracing a new concept, **Marginal Cost Of Risk**. The Marginal Cost of Risk concept delineates a level of risk reduction with intrinsic cost beyond which the additional expenditure of resources makes only small, incremental differences in probable success. In cost-capped programs the incremental risk reduction is frequently at the expense of performance and schedule.

Such philosophy creates interesting tradeoffs. It yields a program formulation that launches less than "perfect" elements traded-off against the number of elements launched. Is it better to launch one expensive very low risk ($R(t) = .99$) spacecraft or to launch four moderate risk ($R(t) = .8$) spacecraft in a shorter period for less cost? In the first case there is enormous expense/launch for one success. In the latter case, there is expectation of multiple successes (3) at moderate cost/launch and with higher perceived and actual value to the taxpayer, our ultimate customer. However, no one likes failure. One could view $R(t) = .8$ as terrible without consideration of the overall value of return on cost of the program. This example obviously requires the avoidance of systematic common mode failures which consequently is a critical place to focus the precious risk management resources. Does this sort of conceptualization encourage failure or promote a flippant attitude toward failure? NO! This conceptualization promotes minimizing the cost of success and risk sharing between the product support disciplines and the real risk owner, the program manager.

This paper will address this new paradigm for risk, challenging new thinking for test effectiveness, analyses, and review. The concept of Marginal Cost Of Risk will be described in more detail with more examples. Discussion of the value of synergisms, discarding low value risk checks/balances and effectiveness evaluation will also be included.